



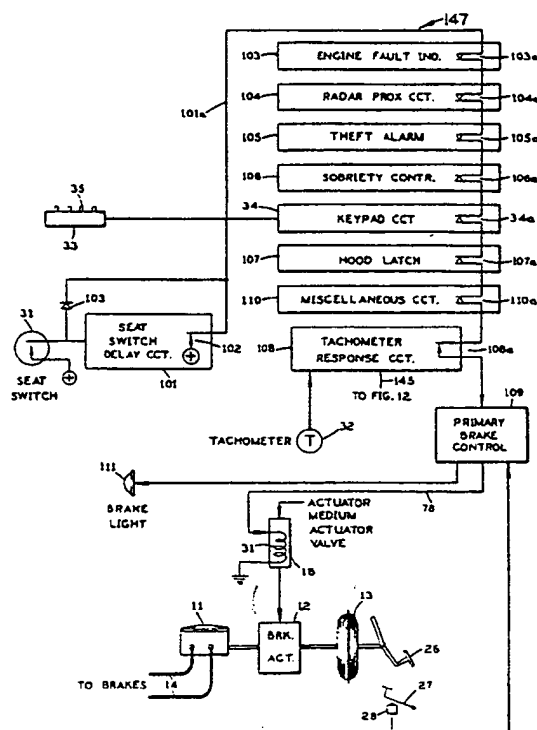
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(54) Title: VEHICLE BRAKE ACTUATOR ARRANGEMENT

(57) Abstract

Vehicle brake actuator (12) serving to automatically control the brakes (11) so that the brakes are operated at a predetermined rate and pressure in a number of indications in which it is desired to automatically brake the vehicle, such as a fault indication (103) from the engine, an indication from a vehicle mounted radar proximity circuit (104) indicating an impending collision, a theft alarm indicator (105), leaving the seat of the vehicle (31), a sobriety control indication (101) for a driver who lacks sobriety, a keypad indicator (34) into which a preselected number must be entered before operating the vehicle, a hood latch monitor circuit (107), a tachometer response circuit (108) that brakes the vehicle if the speed goes below a certain limit, and a miscellaneous circuit (114) that combines a number of indications for braking the vehicle. The brake actuator is operated by means of vacuum, hydraulic pressure or electric power and may include a canister for storing additional vacuum. The system may also include a seat switch delay circuit (101) which prevents unwanted braking if the driver passes a bump in the road. The brake actuator is automatically released the moment the driver operates the gas pedal.



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VEHICLE BRAKE ACTUATOR ARRANGEMENTFIELD OF THE INVENTION

This is a continuation-in-part of Patent Application Serial No. 06/346,551 filed February 8, 1982. The invention relates generally to vehicle braking apparatus and more particularly to an automatic braking apparatus which operates to automatically stop a moving vehicle if the driver leaves the driver's seat.

BACKGROUND AND PRIOR ART

In any vehicle, such as in emergency vehicles used by police, fire, ambulance and in any other types of vehicles in which the driver from time to time has a need to quickly leave the driver's seat under urgent conditions, it occasionally happens that the driver neglects to place the vehicle controls in braked condition, for example, by not throwing the gear lever of an automatic vehicle transmission into the "Park" position, or in the case of a vehicle with manual transmission, he may neglect to set the parking brake. As a result, it sometimes happens that the vehicle continues to coast along without a driver at the controls, and the vehicle may then collide with other vehicles and cause or suffer various damages.

The assignee has four issued patents and two pending patent applications that relate to the hereinabove described subject, namely U.S. Patent No. 3,487,451 (Fontaine) issued Dec. 30, 1969 and entitled Brake Control Means for Vehicles, which discloses the basic concept of automatically actuating

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the brakes of a vehicle when an electric switch installed in the driver's seat senses that the driver has left the seat. Also, patents Fontaine 3,761,138; 3,845,932; and 3,888,552 are of interest on automatic braking. Patent
5 3,846,599 is of interest on a gas pedal switch.

A patent application Serial No. 06/346,551, filed February 8, 1982, entitled Vehicle Brake Actuator Arrangement discloses additional details of a control system for the vehicle brakes, which, besides the electrical seat
10 switch further comprises details of the electrical and pneumatic control elements.

Patent Application Serial No. 06/540,060, filed October 7, 1983, entitled Automatic Brake Actuator with Controlled Release, discloses still further details of a
15 brake control system which is capable of incorporating the use of vehicle theft sensors and other sensors that further enhance the utility of the braking system.

The present invention further advances the art relating to automatic vehicle brake control, and discloses the
20 use of media, other than vacuum, for actuating the vehicle brakes and shows refinements in the electrical control apparatus so that additional capabilities are realized.

A search for prior art has disclosed: U.S. Patent No. 4,244,186 which discloses generally a pilot operated hydraulic brake system; U.S. Patent No. 3,790,223 (Fontaine)
25 which shows a brake control system including a seat switch and a solenoid valve circuit; U.S. Patent No. 3,195,309 which shows a brake mechanism that serves to reduce the effect of worn brake shoes in a manual brake arrangement.
30 U.S. Patent No. 3,895,698 (Fontaine) shows an electrically controlled power brake system which provides automatic braking in response to a plurality of vehicle conditions.

SUMMARY OF THE INVENTION

The present disclosure expands the scope of the art of
35 automatic vehicle braking in that it discloses automatic braking systems that include other braking media than vacuum force, namely hydraulic pressure, as obtained from

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a source of hydraulic pressure in the vehicle that may be separate from the braking system, such as the hydraulic pressure obtained from a vehicle power assisted steering system, or compressed air which is available in certain vehicles, or an electrically powered brake actuator, drawing power from the vehicle's normally provided electric system.

The present invention further expands the scope of conditions that can interact with the brake actuating system, so that, not only the driver's leaving the driver's seat will actuate the brake system, but also other conditions, which briefly summarized comprise:

(1) an attempt to operate the vehicle by an unauthorized driver;

(2) Still another desirable condition for actuating the brakes is the condition that the vehicle is standing still, without the driver touching the accelerator pedal;

(3) an attempt to drive the vehicle if any of the engine fault indications, such as lack of oil pressure, overheating engine or the like indicate that the vehicle is not in drivable condition;

(4) an attempt to operate the vehicle if the hood or hood latch is not properly engaged;

(5) an attempt to drive the vehicle by a driver who may be influenced by alcohol or otherwise be impaired in his ability to operate the vehicle.

Still other conditions may be added which can be used to activate the brakes such as anti-collision (radar) sensing devices, door or tail gate open, etc.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an elevational view of a retro-fit vacuum operated brake actuator consisting of a brake master cylinder, a vacuum operated brake actuator and a conventional vacuum operated brake booster.

Figure 2 is an elevational view of the brake actuator

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seen along the line 2-2 of Figure 1.

Figure 3 is a vertical, cross-sectional view of the brake actuator of Figure 1 showing the interior construction of the brake actuator and the brake booster.

5 Figure 4 is a view similar to that of Figure 3 but showing the brake actuator in its active braking condition.

10 Figure 5 is a digrammatic view of parts of a vehicle with the brake actuator installed and connected to the vehicle wheels with some of the elements of the control system, which are described in more detail in the instant application.

Figure 6 is diagrammatic view of a brake actuator using hydraulic pressure for brake actuation and levered linkage to the brake cylinder.

15 Figure 7 is an enlarged detail view of the linkage of Figure 6.

Figure 8 is a more detailed view of the hydraulically assisted brake actuator showing additional control details.

Figure 9 is a sectional view taken along line 9-9.

20 Figure 10 is an elevational view of a hydraulic brake actuator using additional vacuum assist in actuating the brakes.

25 Figure 11 is a block diagram of the control circuits for the brake actuator which is the major object of the instant application.

Figure 12 is a detailed circuit diagram of a keypad circuit, for disengaging the brake actuator.

Figure 13 is a circuit diagram of the primary brake control circuit for control of the brake actuator.

30 Figure 14 is a delay circuit for the seat switch.

Figure 15 is a tachometer response circuit for detecting no vehicle speed.

Figure 16 shows an electrically assisted brake actuator system.

35 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Before explaining the disclosed embodiment of the present invention in detail, it is to be understood that

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the invention is not limited in its application to the details of the particular arrangement shown, since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not
5 of limitation.

The present invention builds on the herein, supra, listed earlier patent applications and further expands the scope thereof.

Figure 1 is a brake actuator system according to one
10 embodiment of the invention and consists of a conventional master brake cylinder 11 connected to a brake actuator 12 which is in turn connected with a brake booster 13 of conventional construction. A brake shaft 17 coupled to a
15 brake pedal (not shown) to the right of the Figure traverses the booster 13, the actuator 12 and enters the master cylinder 11, wherein pressure on the brake shaft 17 is converted to the hydraulic pressure which is transmitted to the vehicle wheel brakes via the hydraulic lines 14, in
20 conventional manner. A vacuum line 15 leads from an engine-developed vacuum source to an airflow control valve 16, a 3-way 12V. DC skinner type valve, which is electrically piloted and which, when energized, applies vacuum to the interior of the brake actuator 12 for stopping the vehicle.

Figure 2 shows some of the hereinabove described
25 elements seen along the line 2-2 of Figure 1. Figure 3 shows in a cross-sectional view some details of the interior construction of the master cylinder 11, the actuator 12 and the booster 13. These details have all been described in the hereinabove earlier referenced applications, in particular in application Serial No. 6/540,060 and Serial No.
30 6/346,551 as well as in U.S. Patent No. 3,831,698.

Figure 4 shows the assembly of Figure 3 in its brake-activating condition with the space 18 exposed to vacuum which draws the center shaft against the piston 21 of the
35 master cylinder 11 to activate the brakes.

Figure 5 shows in diagrammatic form a part of a vehicle with rear and front wheels 22 and 23 respectively,

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each equipped with a brake 24, operated through hydraulic brake lines 14 from the master cylinder 11 which is, in turn, connected with the brake actuator 12 and the brake booster 13 and the brake pedal 26.

5 A gas pedal 27 is also shown, which has an electric gas pedal switch 28, similar to the type disclosed in Fontaine patent 3,846,599, which is connected with the electric control unit 29.

10 The electric control unit 29 is the central point for the various electric circuits and components that together constitute the object of the instant invention and will be described in more detail hereinbelow.

The electric control unit receives inputs from the seat switch 31, the gas pedal switch 28, a speed sensor 32 and a keypad 33 with pushbutton keys (push keys) 35, and from a number of other inputs 36 shown here collectively as the single box 36, which will be described in more detail hereinbelow.

20 The electric control unit 29 in turn engages and controls the brake actuator via the line 29a through the Skinner valve 16. A brake light 37 is also controlled by the electric control unit 29 via the line 29c.

The electric control unit 29 consists of various control circuits shown in block diagram form in Figure 11, but before describing the details of Figure 11 some additional embodiments of the invention will be described briefly in connection with Figures 6, 7, 8, 9 and 10.

30 The automatic brake actuator has hereinbefore been described as a vacuum operated device, since vacuum is most commonly available in automobiles from the intake manifold and is usually augmented by an engine driven vacuum pump, especially in vehicles equipped with Diesel engines.

Other media, however, can be used for operating the brake actuator and the actuator may be linked to the brake system in ways that are different from those shown in the hereinabove presented embodiments. In Figure 6 is seen a brake actuator 40 with part of the housing wall broken

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away to show an interior diaphragm 51 which is coupled to an intermediate rod 44 which is connected pivotally at pivot point 45 to a lever 52, which has a fulcrum at pivot point 48 and pivotally attached at pivot point 47 to the
5 intermediate shaft 46, interposed between the brake booster 13 and the master cylinder 11. An electrically piloted air valve for control of the actuator 40 is connected to a vacuum source at 43. The pivot point 48 and lever 52 could be housed in the master cylinder.

10 When the valve 41 is actuated by a control circuit, such as shown in Figure 11, via electric wires 42, the vacuum from the inlet 43 is extended to the space 53 in the actuator 40 where it draws the diaphragm 51 with the draw rod 44 to the left and in turn, the lever 52, being con-
15 nected to the draw rod 44 at pivot point 45, moves the short intermediate shaft 46 to the left and actuates the master cylinder 11, which in turn actuates the brakes. The lever 52, being divided by pivot point 47 into a long arm 52a and a short arm 52b gains a leverage which causes corres-
20 pondingly increased pressure to be applied to the master cylinder 11. As a result, a smaller brake actuator 40 may suffice. Figure 7 shows further details of the short intermediate shaft 46 with a pivot bolt 56 transversely disposed in a receiving hole 58 drilled through the short shaft 46, a surrounding sleeve 54, and the lever 52. An axial hole
25 59 at the right end of the short shaft 46 serves to receive the tap end 61 of the booster shaft 62 with a concentric helical spring 57 exerting pressure to keep the two parts, the short shaft 46 and the booster shaft 62, separated when
30 no braking pressure is applied.

Figure 8 shows a linkage arrangement similar to that described hereinabove, but in this case, the actuator 65 is powered by hydraulic fluid pressure drawn from the hydraulic pump 66 driven by the vehicle engine by a pulley 67, as is
35 usually found in connection with power-assisted vehicle steering systems. Hydraulic fluid flows in the direction

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shown by the arrow in fluid line 68 via an electrically controlled pilot valve 69 which is in turn connected to the right hand side of the actuator 65, which contains a diaphragm, as shown in the actuator 40 of Figure 6, and acts upon a similar draw rod 44 and linkage similar to that shown in Figure 7. The return flow of hydraulic fluid takes place via the hydraulic line 73. The pilot valve is electrically controlled via electric wires 78 connected to the circuit of Figure 11. Figure 9 which is seen along the line 9-9 of Figure 8 shows details of the lever 52 which is similar in construction to that shown in Figure 6. Also shown are details of the booster 13, the master cylinder 11 and the linkage therebetween, as described hereinabove.

Figure 10 shows an embodiment using a hydraulic brake actuator 75 of a type that is commercially available from various manufacturers such as Bendix Corp.'s actuator "Hydro Booster" and others.

The commercial model typically contains a so-called valve spool partially shown at 83 which is part of the controlling element in the actuator. Valve spools are conventional in hydraulic control systems.

In a practical embodiment of the invention, the spool 83 has been connected to a small vacuum operated valve actuator 76, containing a diaphragm 77. The left side chamber 82 of the valve actuator 76 is connected to a conventional vacuum source via the vacuum line 81 through an electrically pilot operated air valve 79 of conventional construction. The air valve 79 is controlled by a control circuit such as shown in Figure 11 via two electric wires 78. Hydraulic fluid under pressure is supplied via the fluid line 82.

In normal brake operation, the actuation of the brake pedal 26 drives the master cylinder 11. When automatic brake actuation is to take place, the air valve 79 is energized and admits vacuum to the actuator 76, which in turn forces the spool 83 to move forward, which causes the hydraulic pressure from the hydraulic line 82 to actuate

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the master cylinder 11, which in turn brakes the wheels, via hydraulic brake lines 14.

In the embodiments described hereinbefore, the actuating medium has been described as vacuum or hydraulic pressure. It follows that by suitable, simple modifications to the disclosed apparatus, compressed air may be used instead of compressed hydraulic fluid so that electric power may be used to actuate the brakes, using for example an electric solenoid actuated by the circuit of Figure 11 or a small electric motor.

Alternately, electric power may be used to supply the vacuum or the hydraulic pressure for operating the brake actuator, using conventional components such as electric motors, vacuum or hydraulic pumps or the like, and drawing electric power from the vehicle's electrical system.

Figure 16 shows in diagrammatic form such an electric system for supplying an actuator operating medium, such as vacuum from the vehicle's electric system. Figure 16 shows the brake actuator main elements, already described hereinabove, consisting of the brake pedal 26 engaging the brake assist booster 13 which in turn engages the master cylinder 11 through the brake actuator 12. The brake actuator 12 is controlled by the air valve 16, which is controlled by the electric control circuit, shown in Figure 11 via control lead 78. Vacuum is supplied by an electric motor driving a vacuum pump 91 and an electric motor 92 which is driven by the vehicle's electric system via a vacuum pressure regulator 93, attached to the vacuum storage cannister 15, and having contacts 94. The contacts 94 close when the vacuum in the cannister 15 falls below a certain preset level, as sensed by the vacuum regulator 93, which in turn connect electric power from the vehicle's power bus + which starts the motor 92 driving the pump 91, which in turn draws air from the cannister 15 via a check valve 15a, until the vacuum in the cannister reaches the preset level, which causes the regulator 93 to open the contacts 94 and stop the motor 92 from driving the pump. Such a system,

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clearly would be capable of supplying brake actuating energy for a long time, depending upon the storage capacity of the electric system.

5 The electric control circuit is shown in the block diagram Figure 11, which contains a primary brake control 109, which directly controls the brake actuator control valve 16, which in turn engages and controls the brake actuator 12.

10 The primary brake control 109 is responsive to a number of secondary control units as follows: a seat switch delay circuit 101 connected to and responsive to the seat switch 31, which contains a pair of make contacts that are closed when the driver is in his seat and which apply positive voltage + to a seat switch delay
15 circuit 101, containing a pair of break contacts 102 that are under control of delay circuits in the block 101 and serves to bridge momentary opening of the seat switch contacts 31 if the driver hits a bump in the road, and bounces up from his seat. The seat switch 31 and seat switch delay circuit contacts 102 are connected via lead 101a to an
20 optional engine fault indicator 103 with break contacts 103a that will be opened if an engine indicator shows a type of engine failure, such as lack of oil pressure or the like which may disable the engine. The engine fault indicator contacts 103a next are connected to an optional
25 radar proximity circuit 104 which is mounted on the front of the vehicle and operates to open its break contacts 104a and apply the brakes in case of an impending front end collision.

30 The radar proximity contacts 104a next connect to an optional theft alarm circuit 105 with break contacts 105a which operates to open and apply the brakes if an attempt to tamper with the vehicle is detected.

35 The theft alarm contacts 105a in turn are connected to an optional sobriety control circuit 106 with break contacts 106a which operate to open and apply the brakes if the sobriety control circuit 106 detects that the driver

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attempts to operate the vehicle while under influence of alcohol or drugs.

5 The sobriety control circuit contacts 106a in turn connect to an optional keypad circuit 34 with break contacts 34a which operate to open and apply the brakes in case the driver keys in the wrong code on a keypad 33 before attempting to start the vehicle.

10 The keypad circuit contacts 35 in turn are connected to an optional hood latch circuit 107 with break contacts 107a which operate to apply the brakes if the hood latch is open.

15 The hood latch contacts 107a are in turn connected to an optional miscellaneous circuit 110 with break contacts 110a which operate to open and apply the brakes in case of the occurrence of any number of miscellaneous non-specified conditions that may make it undesirable to allow the operation of the vehicle. Such conditions may, for example, be switches on armored car doors, tailgates, etc. or for any number of other non-specified conditions.

20 The miscellaneous circuit contacts 110a are in turn connected to an optional tachometer response circuit 108 connected to a tachometer 32, which may conveniently be connected to the vehicle's speedometer cable for measuring the vehicle's speed. The tachometer response circuit 108
25 contains a pair of break contacts 108a that operate to open and apply the vehicle brakes when the vehicle speed is reduced to zero rate of speed, and may include a delay pack, that when activated, the driver will no longer need to hold his foot on the brakes (26) to cause the vehicle to
30 remain stationary.

 The entire chain 147 of series connected break contacts, 102, 103a, 104a, 105a, 106a, 34a, 107a, 110a and 108a, described herein, supra, are in turn connected to a primary brake control circuit 109, which operates to apply the vehicle brakes if any of the series connected break 147 contacts is opened, and break the chain.
35

 The primary brake control circuit 109 in turn controls the actuator valve 16 via the lead 78, which in response

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operates the brake actuator 12 if the chain of series-connected break contacts 147 is broken at any point.

The primary brake control circuit 109 is also responsive to the operation of the gas pedal 27 which has an associated switch 28, containing a pair of make contacts which operate on the primary brake control to release the brake actuator 12. The primary brake control 109 also is connected to a rear or top-mounted brake light 111 that is automatically turned on to show that the vehicle is standing still.

The construction of the individual control blocks briefly listed hereinabove, will now be described in more detail.

The seat switch delay circuit 101 is shown in Figure 14, wherein the seat switch 31, when closed, applies positive battery + through resistor R1 to the inverting input 4 of an amplifier 121, which is also shunted to ground by the parallel connected capacitor C1 and the variable resistor VR1, which together form a time constant of typically a few seconds that maintains the output 2 of the amplifier 12 at a low potential which keeps the transistor 122 in its off condition and the relay RL1 un-operated with its break contacts 123 closed for those few seconds. In case the seat switch 31, which is closed with the driver in the seat, should bounce and momentarily open its contacts, the capacitor C1 at the amplifier input 4 will prevent the relay RL1 from operating until a time delay of a few seconds has elapsed. Other components, such as the zener diode Z1, the resistors R2, R3, R4 and others serve to support the operation of the amplifier 121 in well known manner.

The tachometer response circuit 108, shown in detail in Figure 15, consists of three series connected amplifiers 126, 127 and 128, of which the input to the amplifier 126 is connected to the tachometer 32 (Figure 11) connected to the speedometer cable and which comprises substantially a small AC-generator of well known construction that produces an AC-voltage of a frequency that is generally

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proportional with the speed of the vehicle. The AC-voltage to the input of the amplifier 126 is amplified and rectified and filtered in the network shown in the dashed line box 129, the output of which is connected to the inverting input 4 of the amplifier 127, which further amplifies the output from the box 129 and further filters it in the network consisting of resistor R5 and capacitor C5, which in turn is connected to the inverting input 10 of the amplifier 128 through the zener diode Z2, and which has a network consisting of the parallel connection of zener diode Z1 and resistor R6 connected to its non-inverting input 11.

The amplifier 128 with input zener diodes Z2 and Z1 forms a threshold circuit, so that the output of the amplifier 128 is low when the input potentials to the input terminals 10 and 11 are above a certain selected threshold value determined by the zener diodes Z2 and Z1 but rises to a positive voltage when the input voltage falls below the selected threshold value, which in turn activates the transistor 131. The transistor 131 turning on operates the relay which opens its break contacts 132a; this action in turn momentarily operates the relay 133 through the capacitor C9 (after about 4 seconds), which momentarily opens its contacts 108a which are also shown in the contact chain of Figure 11 described hereinabove.

The construction of the keypad circuit 34 of Figure 11 is shown in detail in Figure 12, in which a keypad 141 with n pushkeys KP1-KPn is shown in the dashed line box 141.

The keypad circuit requires that certain keys, e.g. keys KP1-KP4 are operated one at a time, in the sequence shown, in order to disengage the brake actuator. The circuit further comprises, e.g., four each four-input NAND-gates A1, B1, C1 and D1, that each can be activated by a certain combination of the flip-flops FFA, FFB, FFC and FFD, each having a pair of output leads, of which the upper one is the true and the lower one is the inverted output; e.g., the flip-flop FFA has an upper true output A which is high

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when the flip-flop is set, and low when it is cleared, and the lower inverted output \bar{A} which is high when the flip-flop is cleared and low when it is set. Accordingly, when the circuit is cleared, all inputs to the NAND-gate
 5 A1 are high, causing the upper input S to the two-input NAND-gate A3 to be high, through the inverter A2. Now, to begin setting the keypad circuit, the first key, KP1 is operated and sends a plus twelve volt potential to the lower input R of the NAND-gate A3, which is therefore ac-
 10 tivated and produces a low at the input S of the flip-flop FFA. This flip-flop is a so-called J-K flip-flop that responds to a low-going edge at its input S and is therefore being set, so that its output A goes high and \bar{A} goes low. The remaining three flip-flops FFB, FFC and FFD are
 15 still in cleared state.

As a result, the four-input NAND-gate B1 which has the inputs A, \bar{B} , \bar{C} , \bar{D} becomes enabled, while the NAND-gate A1 becomes disabled. Similarly the key KP2 and only that one, must be operated to set the flip-flop FFB. If another key,
 20 e.g., key KP3 were operated, it would have no effect on FFC because the NAND-gate C1 would not be enabled at this time. Also, if one of the keys KP5-KPn were, in error, operated, all four flip-flops FFA-FFD would be reset by a plus twelve volt potential through OR-gate 142 at the upper input to
 25 NAND-gate 143 combining with a high on the lower input of NAND-gate 143 from the output lead 145 through inverter 144 from the tachometer response circuit 108, indicating that the vehicle speed would be low at this time. The low output thus produced from NAND-gate 143 would reset all the
 30 flip-flops FFA-FFD through AND-gates A4-D4 to the R input of the flip-flops.

Returning now to the operation of the key KP2, the second flip-flop FFB would be set, and in the same manner as described hereinabove, the third NAND-gate C1, having
 35 inputs A, B, \bar{C} , \bar{D} would be prepared for the operation of the third key KP3 and only that one, and in the same way, the fourth flip-flop FFD would be set by the fourth key KP4.

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With all four flip-flops set, the four inputs A, B, C & D to the four input NAND-gate G1 would all be high, and its output would go low, which would operate the relay G3 through the driver G2, and close its contacts 34a, which was described hereinabove under the description of Figure 11, and which is one of the conditions for releasing the brake actuator 12. This condition is designated the "Green Condition" which allows the vehicle to operate, as opposed to the "Red Condition" that is created when all the flip-flops FFA-FFD are in the cleared state and therefore enable the four-input NAND-gate R1, having the input condition \bar{A} , \bar{B} , \bar{C} , \bar{D} , which will operate the relay R3, the contacts 146 of which will be open, and break the chain of contacts, shown as 147 at the bottom of Figure 12 and in a dashed line box 147 in Figure 13.

A section of the keypad circuit, shown at the bottom of Figure 12 serves to reset all the flip-flops FFA-FFD, consists of the relay K2 which is connected to plus twelve volts at one coil terminal in series with the seat switch 31 and the chain of contacts 147 of all the circuits of Figure 11 and the lead 148 leading to Figure 13 which is the primary brake control, through the coil of the relay R1 of the primary brake control to ground, which is also connected to the minus side of the vehicle electric system. Before the entire chain is closed, the relay K2 of Figure 12 is not operated and plus twelve volt potential is applied through the lower input of OR gate 142 to the upper input of NAND-gate 143 which with the high at its lower input from the tachometer response circuit 108 presents a low to the R input of all flip-flops FFA-FFD. When the driver enters the seat and closes the seat switch 31, and the chain 147 is closed, relay K2 operates, and places a low on the lower input to OR-gate 142, which in turn through NAND-gate 143 presents a high to the R input of all flip-flops FFA-FFD. This high prepares the R-inputs to clear the flip-flops FFA-FFD in case one of the wrong keys KP5-KPn should be operated, as described hereinabove.

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The primary brake control 109 is shown in detail in Figure 13. Its operation has been described in detail in the herein, supra, referenced patent application Serial No. 06/540,060 in Figure 6 of the reference, and the nomenclature from that Figure has been retained in Figure 13. Referring now to Figure 13 of the instant disclosure, the relay R1 is operated by plus twelve volts from the battery 87, through ignition key 82, through seat switch 31 and the contact chain 147 and relay R1 to ground. Relay R1 operating closes its contact r1, which prepares the relay R2 for operation, but the relay R2 cannot operate until its coil circuit is completed to ground through make contacts 84 of the gas pedal switch 28, seen in Figure 5. When the gas pedal 27 is operated, contacts 84 close, and the relay R2 operates and stays operated through its own make contacts r2" to ground, until the chain 147 or the seat switch 31 is opened. With the relay R2 operated, its contacts r2' are also closed and energizes the two coils 31 and 98. The coil 31, which is part of the actuator valve 16 of Figure 11, removes actuator medium to the actuator 12, which thereby releases the hydraulic pressure on the brakes. The coil 98 is the operating coil of an optional valve that may be inserted in the flow of air that operates the actuator 12 to impede the speed of airflow in order to make the braking action more slow and gentle. This second valve is also described in aforesaid referenced patent application Serial No. 06/540,060.

The operation and construction of the circuits: engine fault indicator 103, radar proximity circuit 104, theft alarm 105, sobriety control 106, hood latch 107 and miscellaneous circuit 110 will typically depend on the type of vehicle on which the present invention is applied, and are normally supplied by different manufacturers who specialize in such circuits. It follows that if one or several of these optional circuits are not used, or installed, the contact chain 147 will have to be completed by jumper wiring which is not shown, in order to retain a complete electric circuit.

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I CLAIM:

1. In improved vehicle brake actuator, the vehicle which has a hydraulic brake system with a release switch, a source of pressure medium for the brake actuator, the improved brake actuator which comprises:
- 5 a brake actuator housing;
a movable pressure medium responsive component disposed inside the housing and dividing it into a pressure side and a neutral side;
10 mechanical linkage for connecting the pressure responsive component with the master cylinder for actuating the brakes; and
brake actuator control means for activating the pressure responsive component in response to
15 a requirement for braking the vehicle, and responsive to said release switch for deactivating the vehicle brakes.
2. Improved vehicle brake actuator according to claim 1, further comprising a master cylinder and a brake booster for providing power assistance to the brake system; a brake pedal for braking the vehicle; mechanical linkage
5 interposed between the brake pedal and the booster for actuating the booster; and mechanical linkage between the booster and the master cylinder for actuating the brakes.
3. Improved vehicle brake actuator according to claim 2 wherein said requirement for braking the vehicle is any combination of one or more of the indications;
- 5 the driver leaving the driver's seat;
a no speed indication from a tachometer response circuit;
a theft indication from a theft alarm circuit;
a wrong number indication from a keypad circuit;
a hood latch fail indication;
10 a lack of sobriety indication from a sobriety control circuit;
a proximity indication from a radar proximity circuit; and

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15 a miscellaneous brake operating indication from a
miscellaneous circuit.

4. Improved vehicle brake actuator according to
claim 3, wherein said brake actuator control means further
comprise:

5 a primary brake control circuit responsive to
said requirement for braking the vehicle;
a seat switch;
a seat switch delay circuit responsive to said
seat switch for introducing a delay in the
release of said seat switch, the seat switch
10 operatively engaging the primary brake control
for braking the vehicle.

5. Improved vehicle brake actuator according to claim
4 further comprising an actuator valve, the valve which is
operatively responsive to said primary brake control circuit
for controlling said pressure medium for energizing
5 the actuator.

6. Improved vehicle brake actuator according to
claim 2 wherein said pressure medium is vacuum.

7. Improved vehicle brake actuator according to
claim 6 wherein said pressure responsive component is a
diaphragm.

8. Improved vehicle brake actuator according to
claim 7 further comprising a vacuum canister for stored
vacuum and a check valve interposed between said source of
pressure medium and said canister, said canister in fluid
5 communication with said actuator valve for supplying vacuum
thereto.

9. Improved vehicle brake actuator according to
claim 8 further comprising an electric vacuum pump, a
vacuum regulator for sensing lack of vacuum in said canister,
said electric vacuum pump operatively responsive to said
5 vacuum regulator for supplying vacuum to said canister.

10. Improved vehicle brake actuator according to
claim 2 wherein said pressure medium is hydraulic fluid.

11. Improved vehicle brake actuator according to

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claim 10 wherein said source of pressure medium is a hydraulic pump.

12. Improved vehicle brake actuator according to claim 11, wherein said pressure responsive component is a hydraulic piston, further comprising a hydraulic cylinder for containing said hydraulic piston.

13. Improved vehicle brake actuator according to claim 12 wherein said mechanical linkage further comprises:

a lever having a fulcrum and a long section and a short section;

5 the short section operatively engaging said master cylinder; and
the long section operatively responsive to said hydraulic piston for operating said master cylinder.

14. Improved vehicle brake actuator according to claim 12 wherein said hydraulic cylinder further comprises:

a spool for controlling said hydraulic piston;
and

5 a vacuum-operated spool controller for operating said spool.

15. Improved vehicle brake actuator according to claim 2 wherein said brake actuator control means further comprise any combination of any one or more of:

5 engine fault indicator;
radar proximity circuit;
theft alarm circuit;
sobriety control circuit;
keypad and keypad circuit control circuit;
hood latch monitor circuit;
10 tachometer response circuit;
seat switch delay circuit; and
miscellaneous circuit.

16. Improved vehicle brake actuator according to claim 4, further comprising a brake light responsive to said primary brake control to indicate that said vehicle is in braked condition.

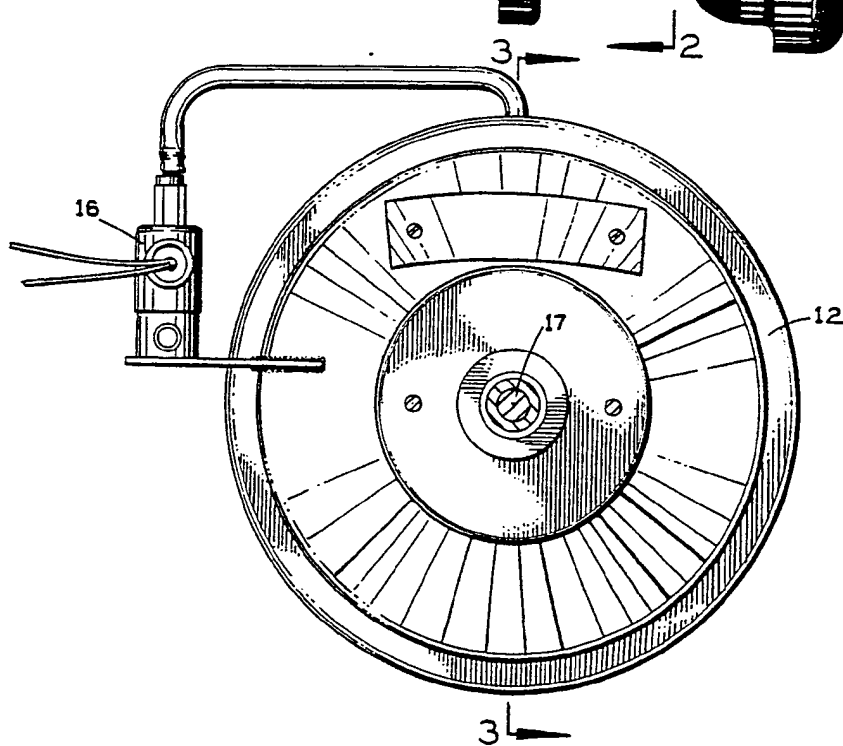
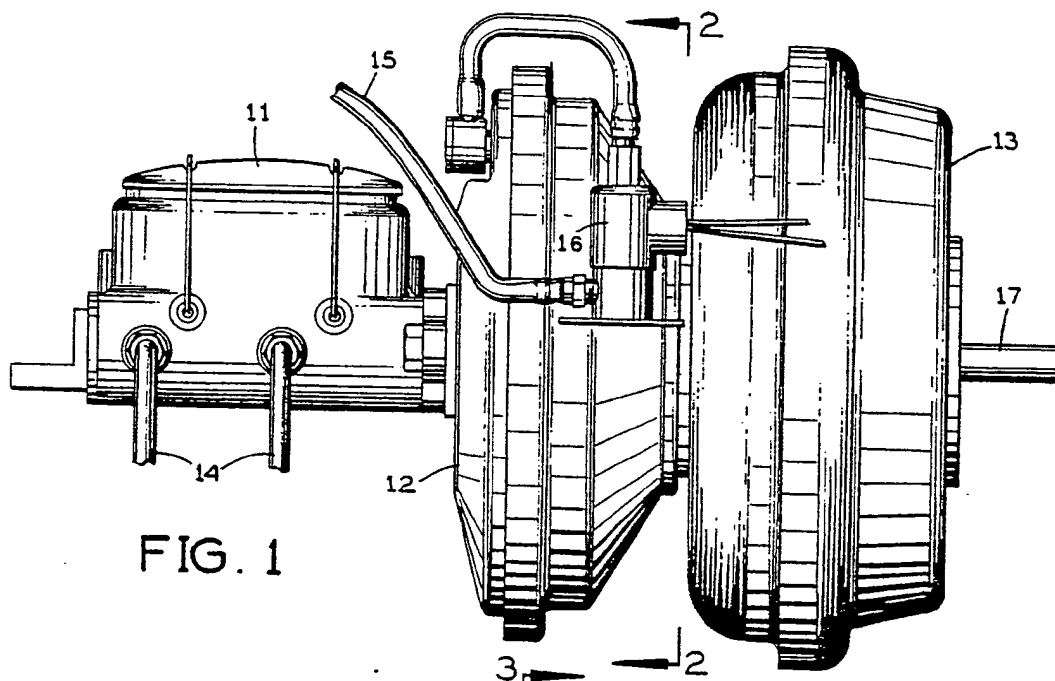
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17. In improved vehicle brake actuator, the vehicle which has a hydraulic brake system with a master cylinder, a source of pressure medium for the brake actuator, the improved brake actuator which comprises:

- 5 a housing;
- a movable pressure medium responsive component disposed inside the housing and dividing it into a pressure side and a neutral side;
- mechanical linkage for connecting the pressure
- 10 responsive component with the master cylinder for actuating the brakes; and
- brake actuator control means for activating the pressure responsive component in response to a requirement for braking the vehicle;
- 15 said master cylinder containing at least part of said mechanical linkage.

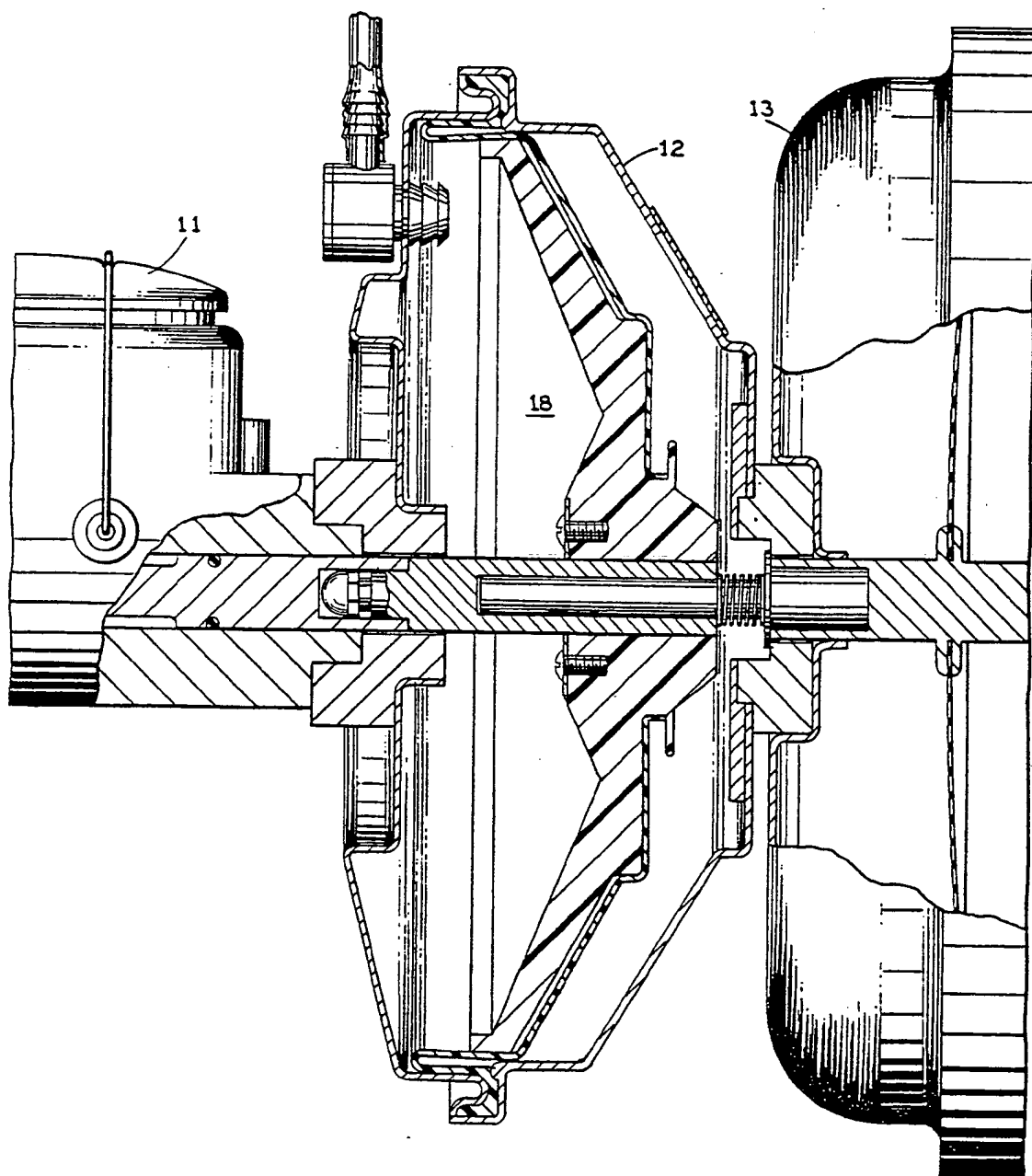
18. Improved vehicle brake actuator according to claim 17, further comprising a brake booster for providing power assistance to the brake system; a brake pedal for braking the vehicle; mechanical linkage interposed between the

- 5 brake pedal and the booster for actuating the booster; and
- mechanical linkage between the booster and the master cylinder for actuating the brakes.



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FIG. 3



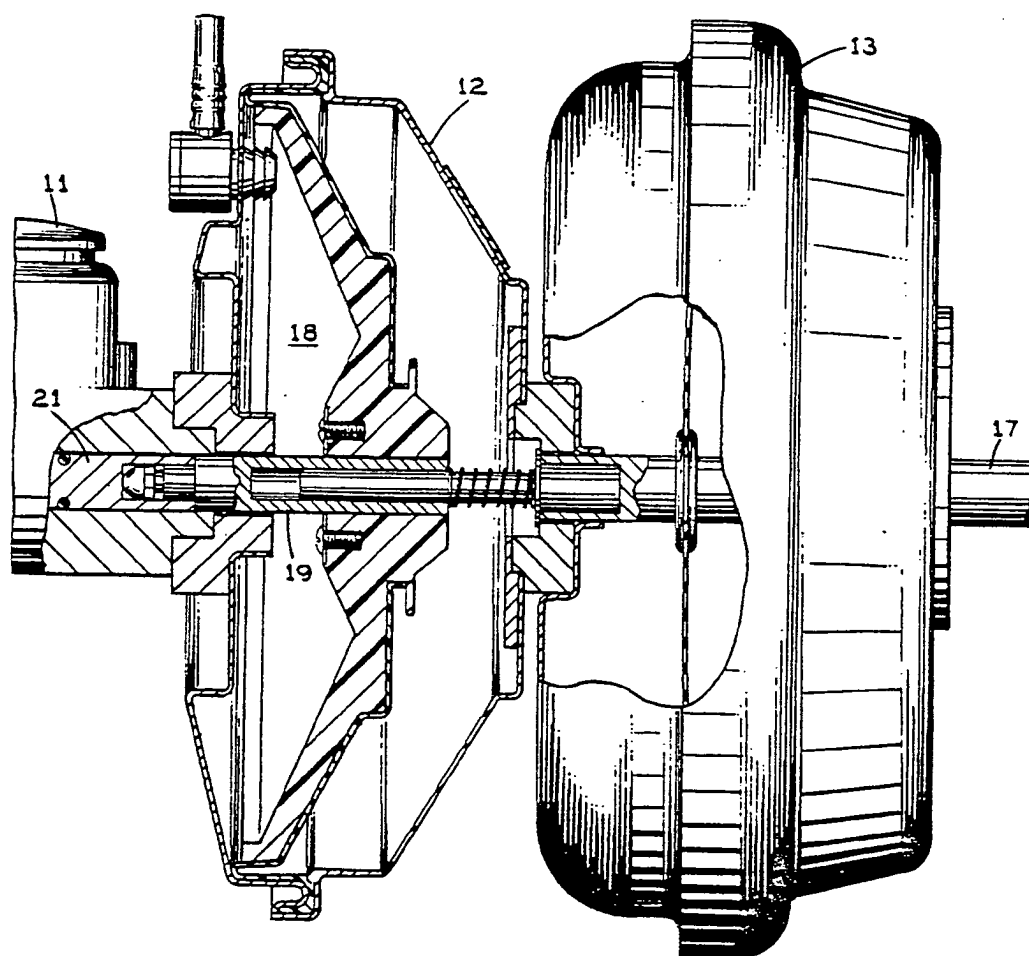


FIG. 4

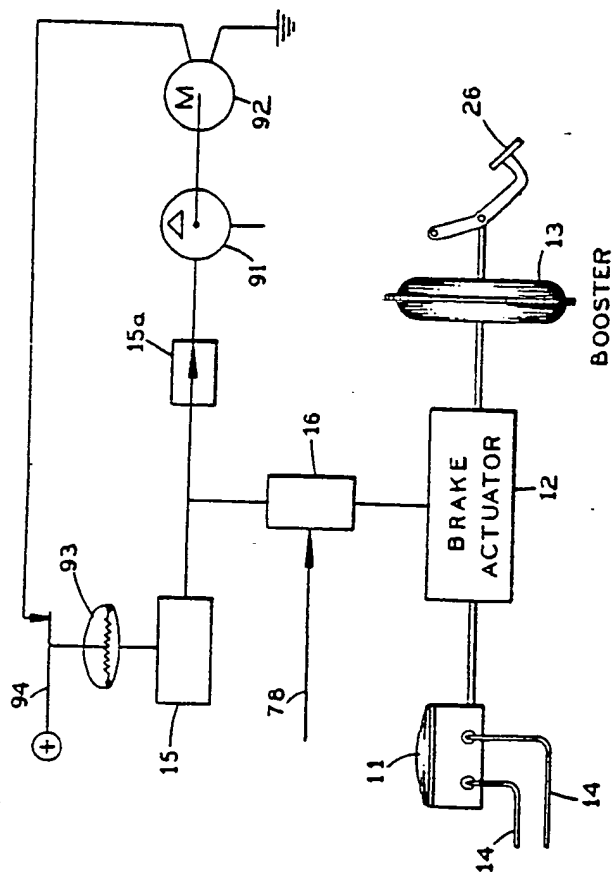


FIG. 16

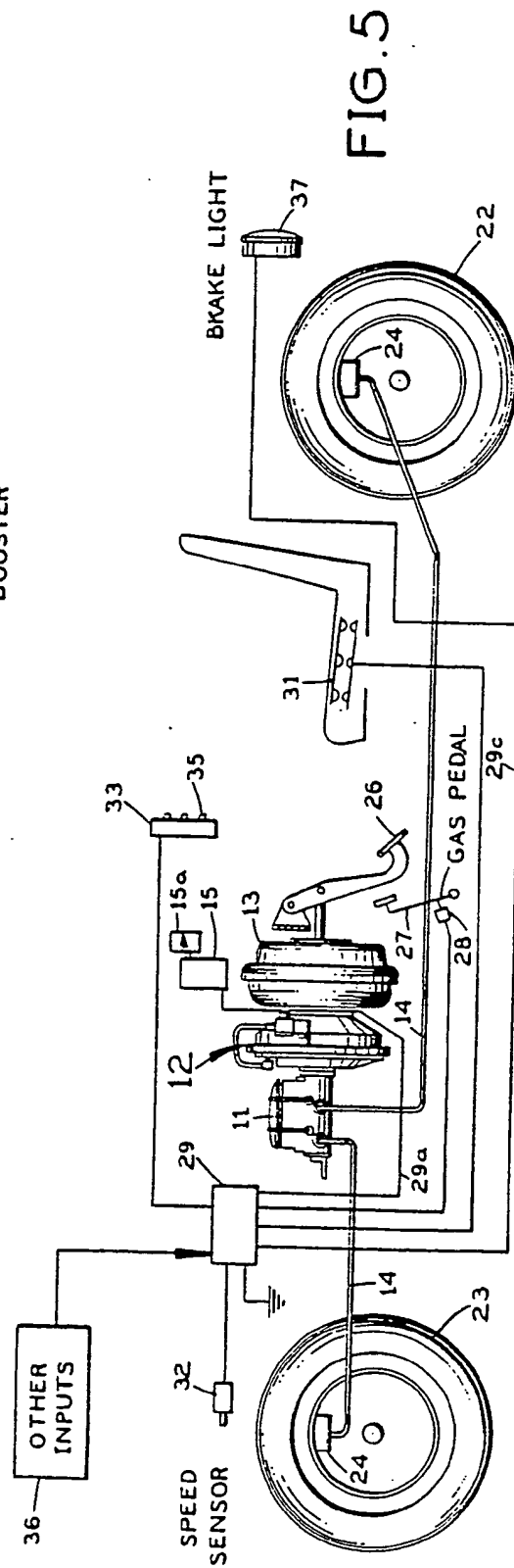
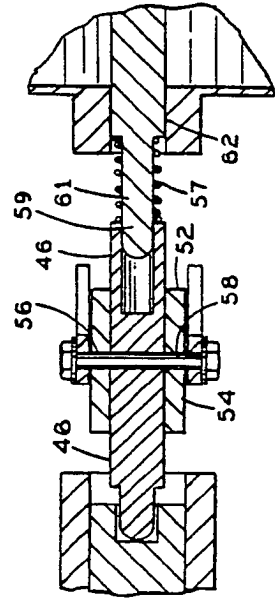
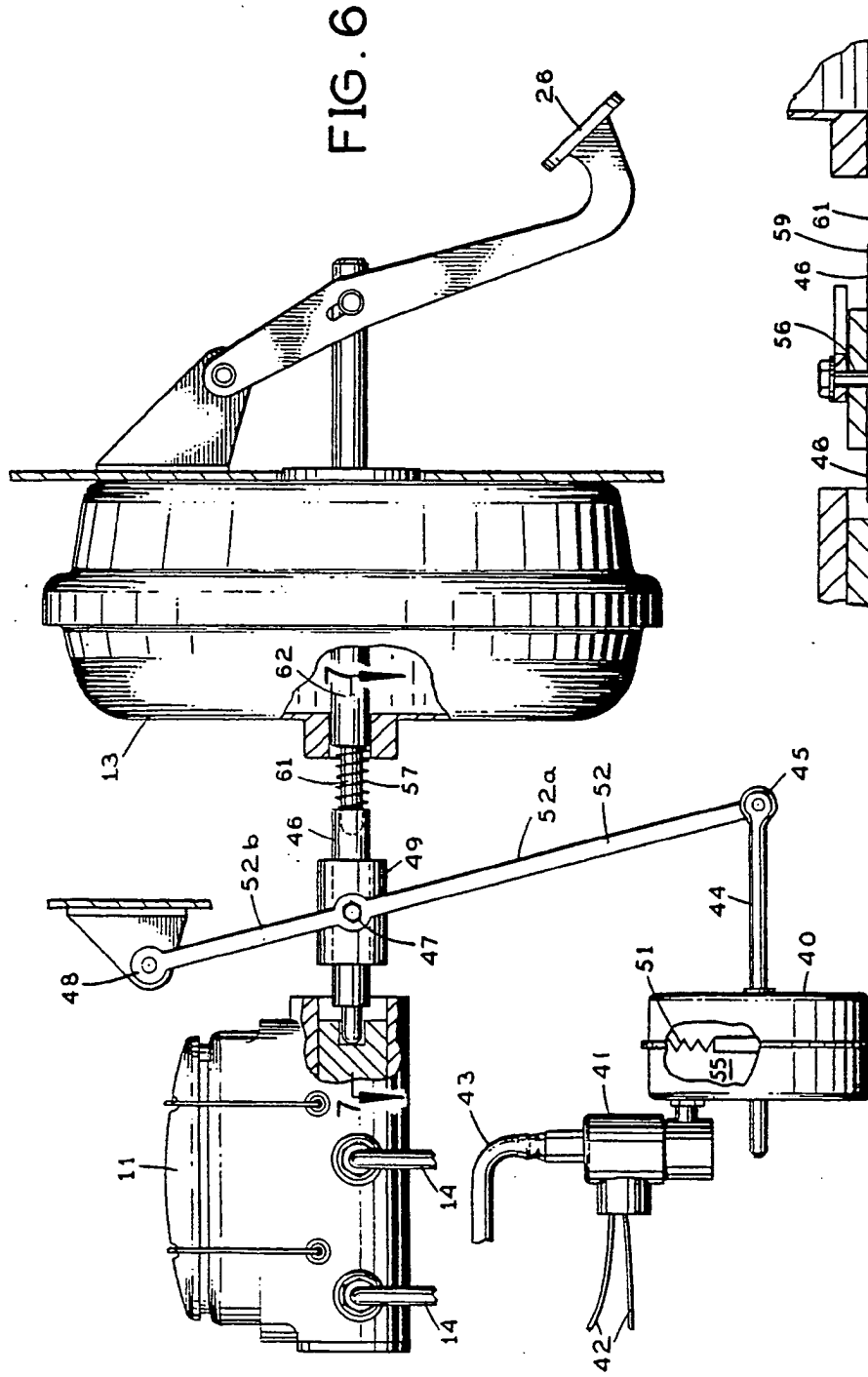
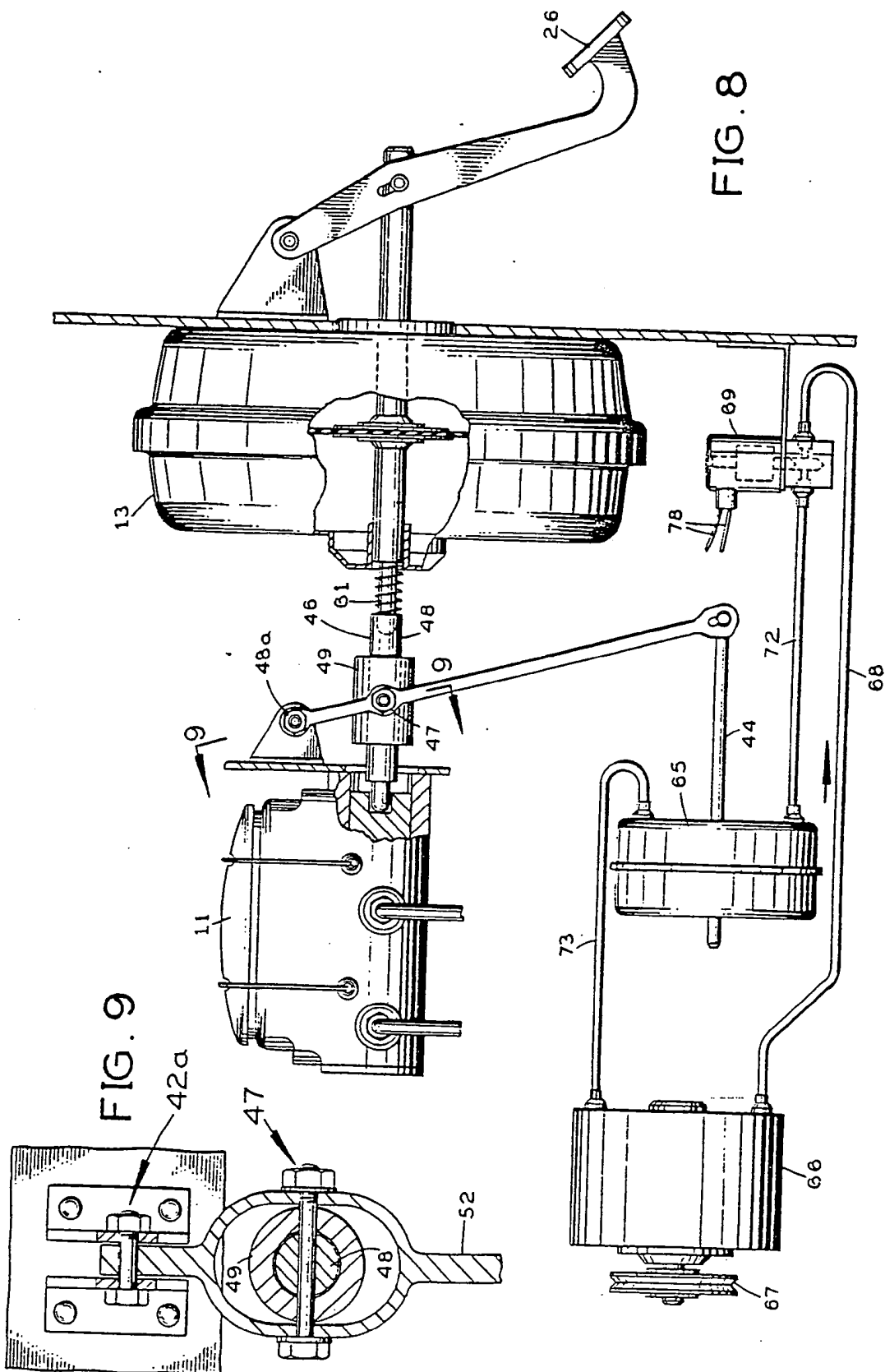
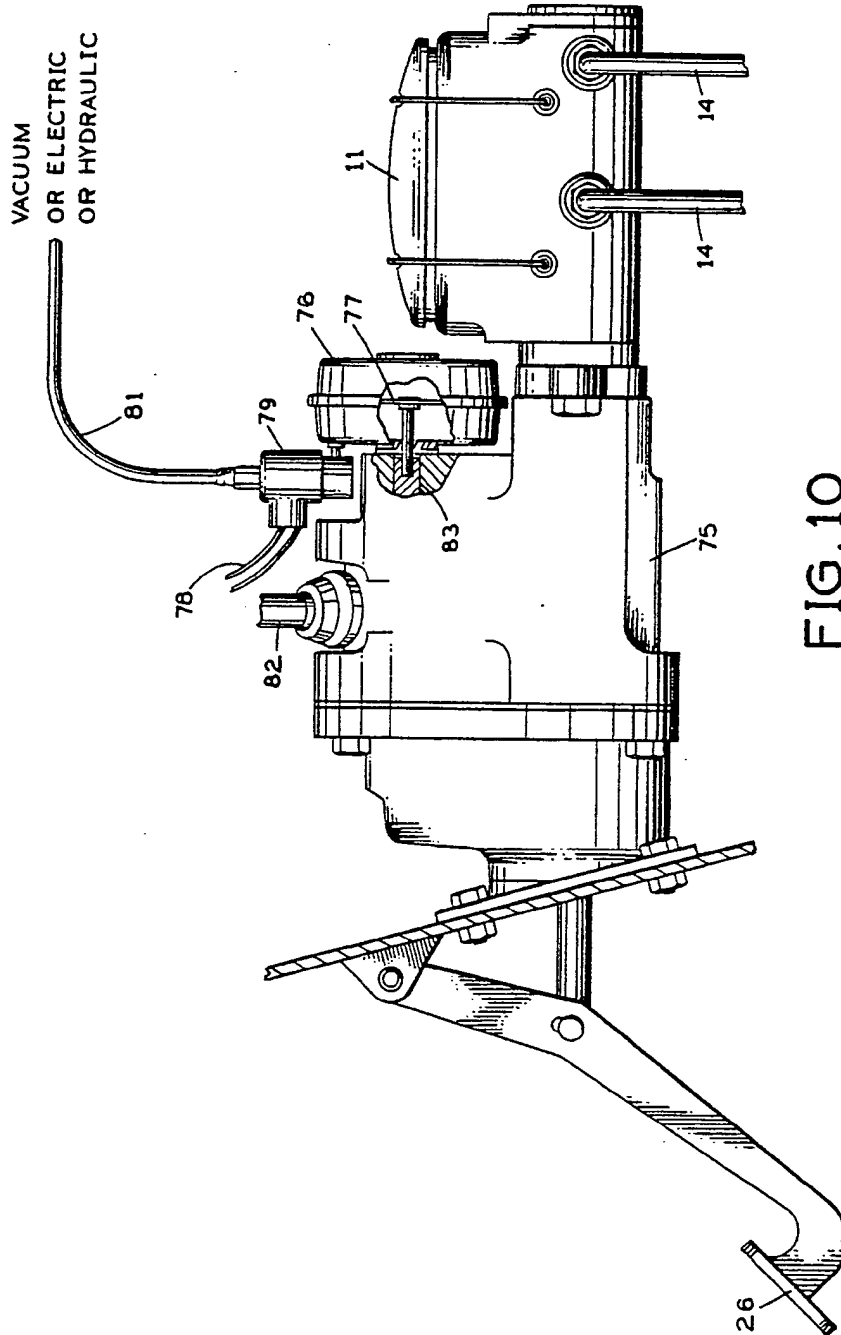


FIG. 5







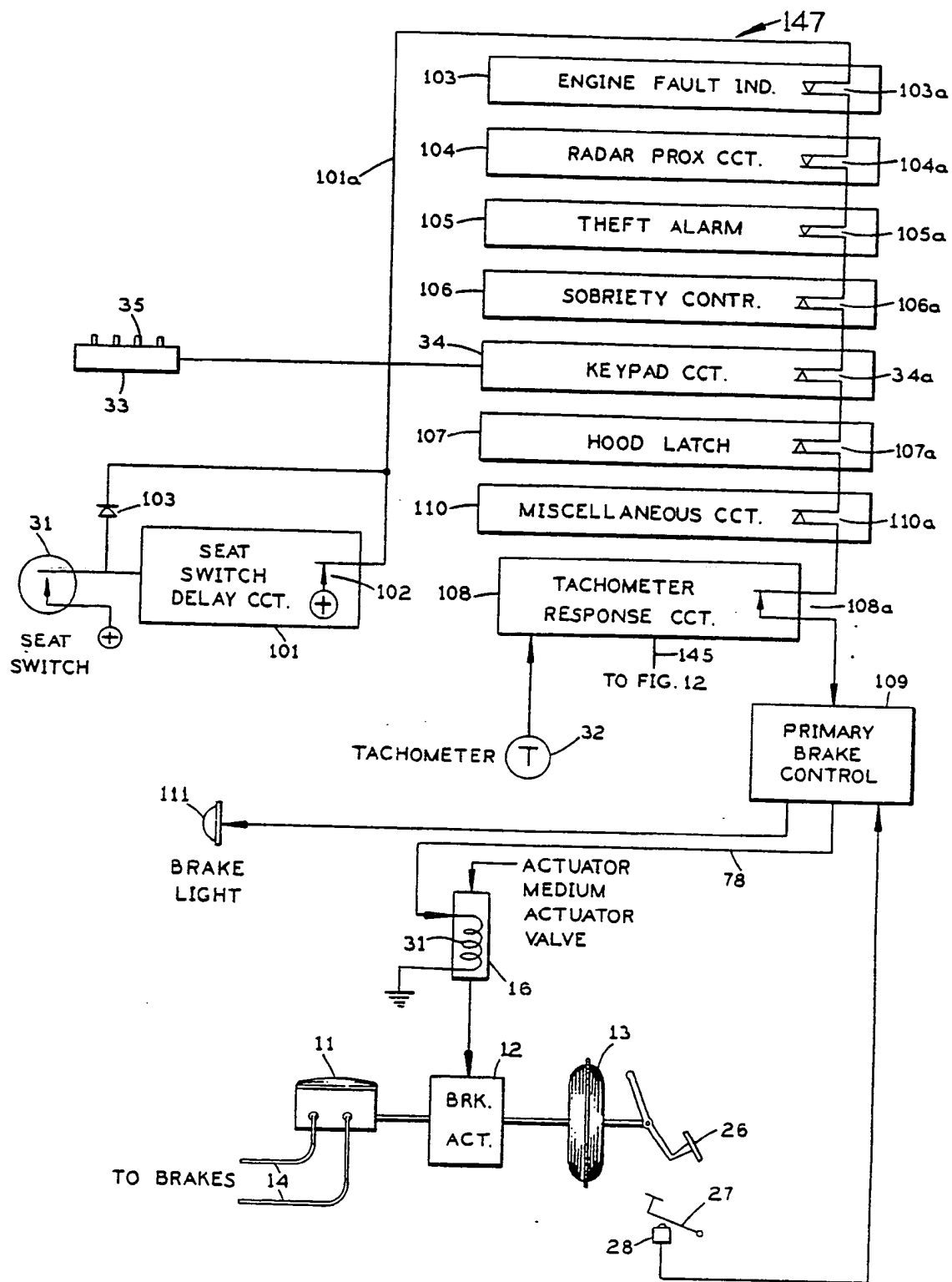
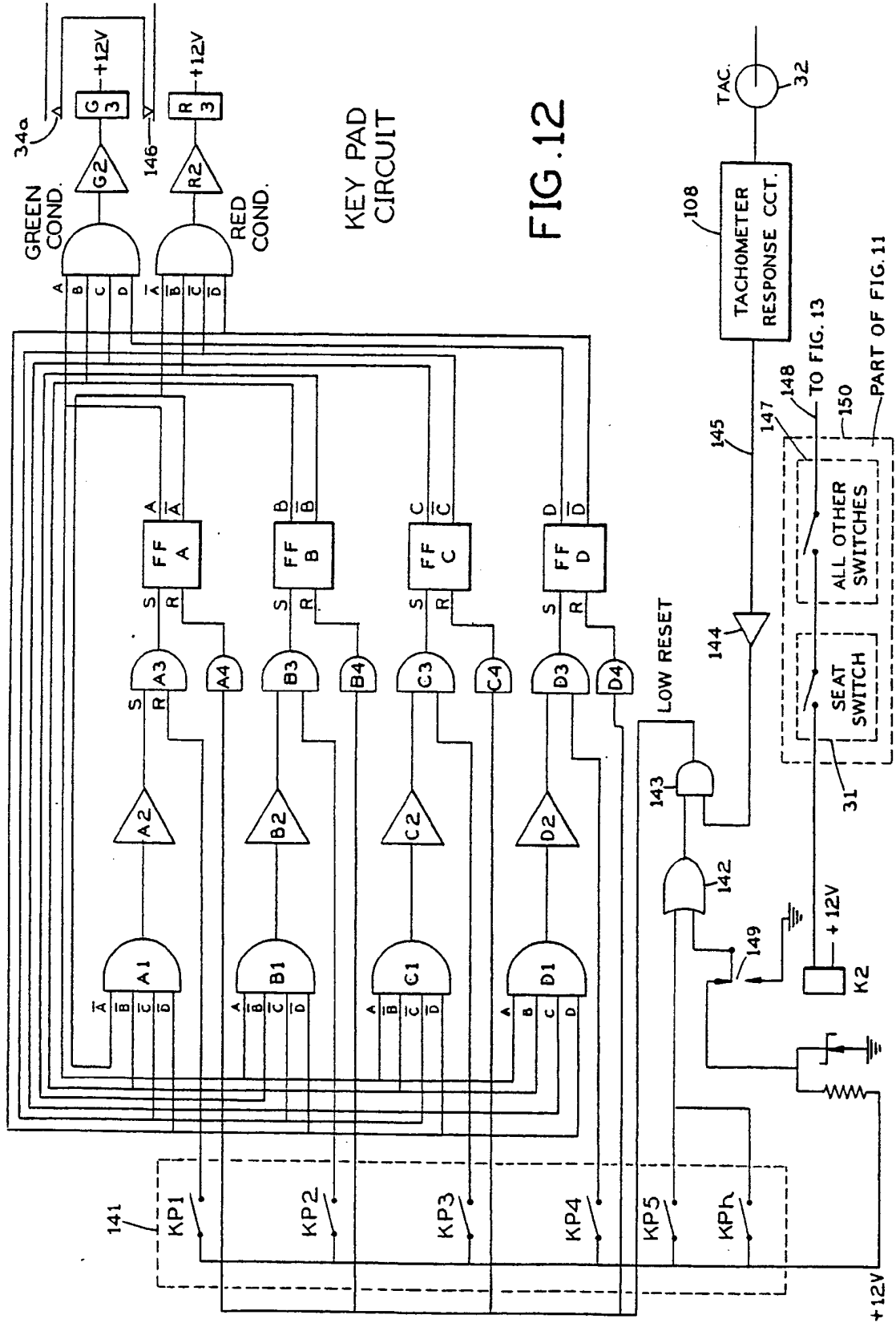


FIG. 11



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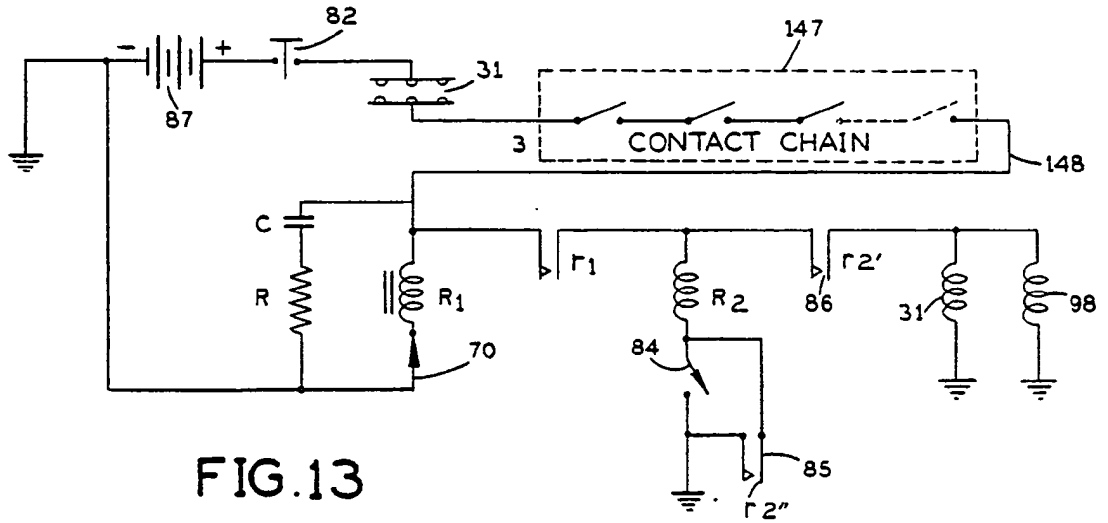


FIG. 13

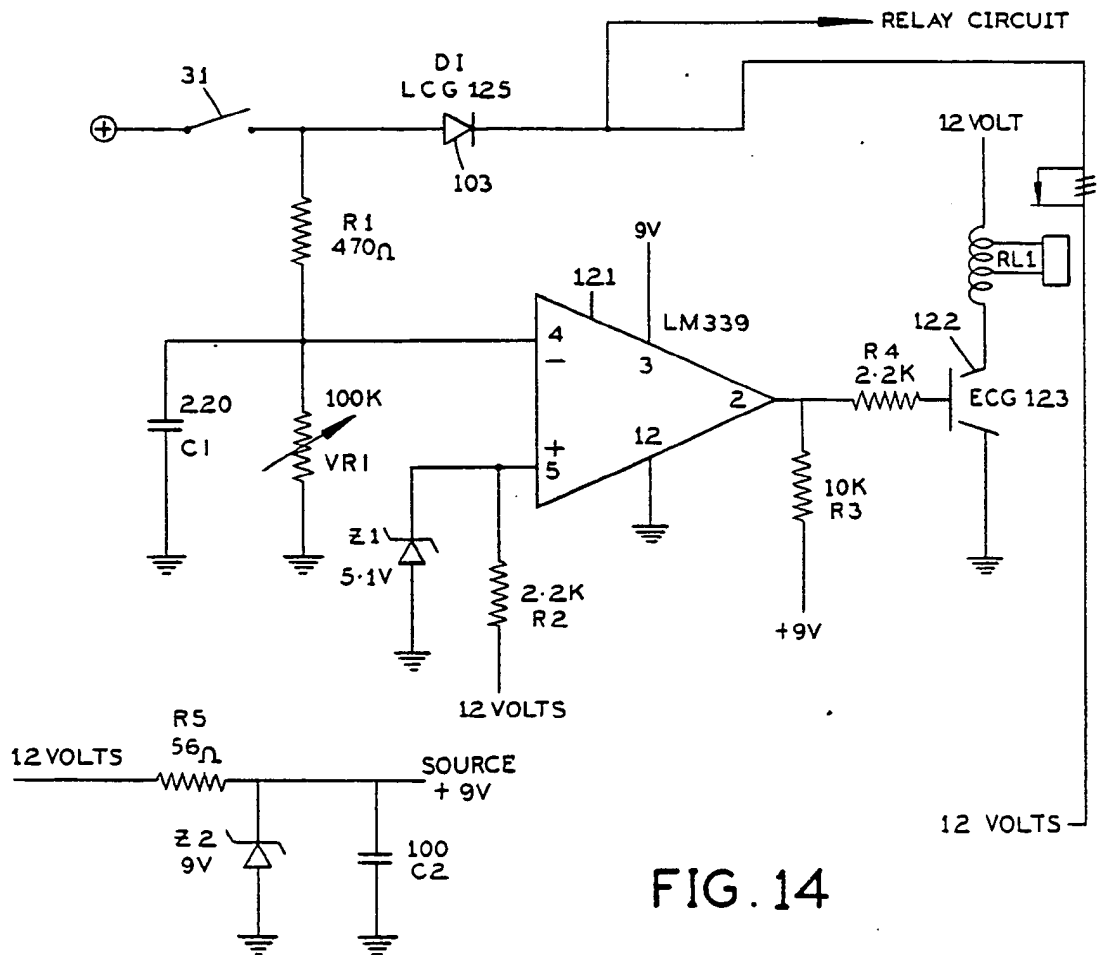


FIG. 14

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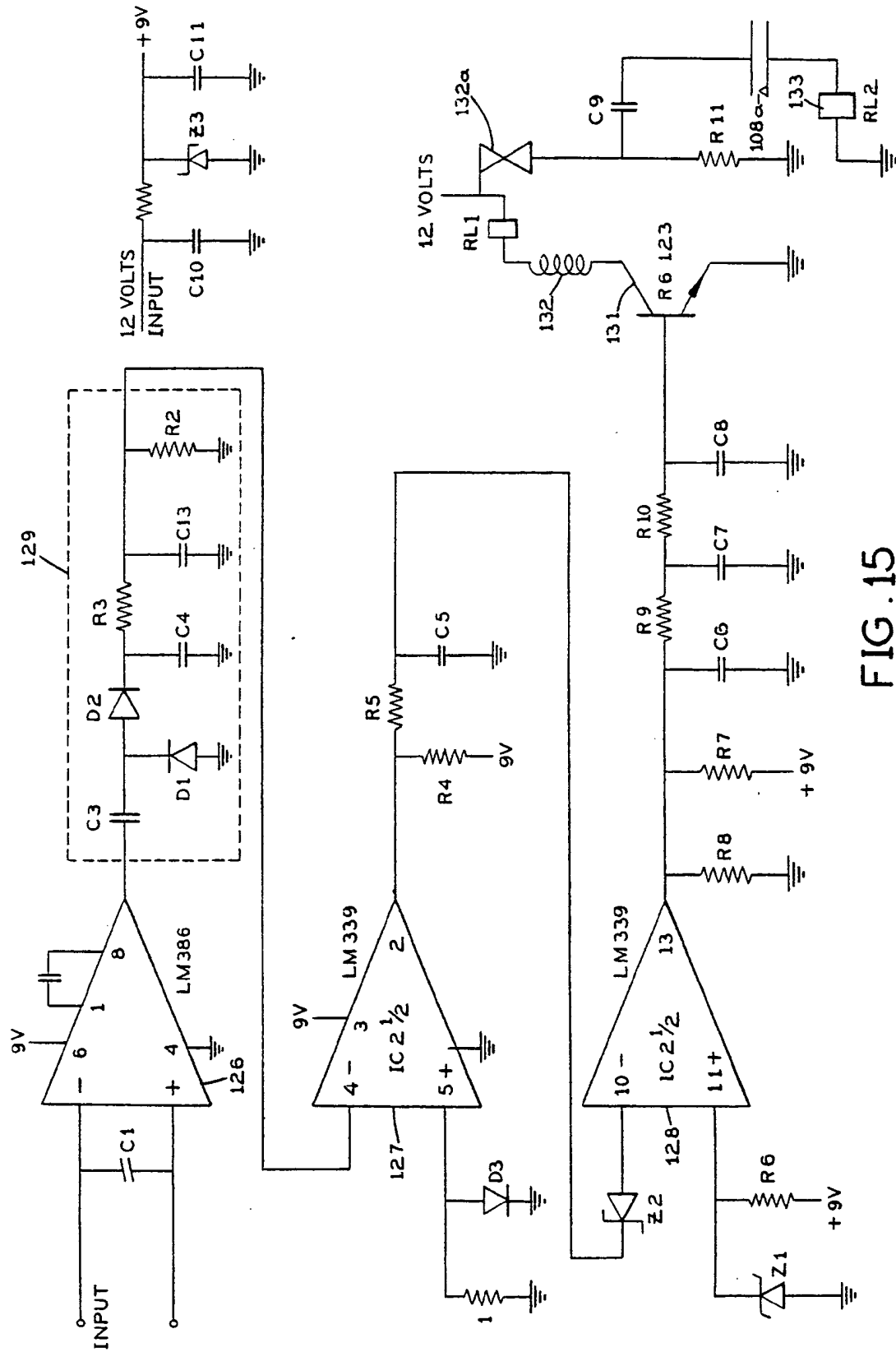


FIG. 15

INTERNATIONAL SEARCH REPORT

International Application No PCT/US85/01138

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. 4 B60T 13/66 U.S. Cl. 60/545 180/273 180/275 188/109		
II. FIELDS SEARCHED		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
U.S.	60/545, 551, 560, 593, 594, 547.1 180/273, 275 188/109; 303/19	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT 14		
Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X	US, A 4,244,186 13 January 1981 Mehren	1,2,10-12, 17-18
Y	US, A 3,830,330 20 August 1974 Fontaine	3,14,15
Y	US, A 4,172,980 30 October 1979 Hsieh et al.	4,5
Y	US, A 3,761,138 25 September 1973 Fontaine	6-8
Y	US, A 3,799,300 26 March 1974 Cochrane et al.	9
Y	DE, A 1,163,694 20 February 1964 Hupp et al.	13
Y	US, A 3,048,979 14 August 1962 Grigsby et al.	16
Y	US, A 3,500,946 17 March 1970 Boyajian	4, 5
<p>* Special categories of cited documents: 15</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Δ" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 1	Date of Mailing of this International Search Report 1	
30 August 1985	13 SEP 1985	
International Searching Authority 1	Signature of Authorized Officer 11	
ISA/US	<i>Richard A. Meyer</i>	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

Y	US, A 4,389,154	21 June 1983 Minor et al.	4,5
A	US, A 3,871,497	18 March 1975 Bessiere	
A	US, A 3,895,698	22 July 1975 Fontaine	
A	US, A 3,845,932	5 November 1974 Fontaine	
A	US, A 3,487,451	30 December 1969 Fontaine	

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.